

CLAIMS

We claim:

1. An apparatus for detecting faults and providing diagnostics of a refrigeration system, comprising:
 - means for measuring five parameters associated with the refrigeration system; and
 - means for detecting faults that communicates with said measuring means, said detecting means calculates results based on the five measured parameters and outputs diagnostic information.
2. The apparatus of claim 1 wherein the means for measuring comprises a data collection unit comprising a means for providing power, a first microprocessor, a first memory, five sensors, and a data port for assisting in the communication with said calculating means.
3. The apparatus of claim 2 wherein the five sensors includes three thermistors for measuring temperatures and a manifold gauge for measuring two pressures.
4. The apparatus of claim 3 wherein the temperatures include suction line temperature, liquid line temperature, and outdoor atmospheric temperature, and the pressures include liquid line refrigerant pressures and suction line refrigerant pressure.
5. The apparatus of claim 2 wherein said power providing means comprises a battery.
6. The apparatus of claim 2 wherein the calculating means comprises a second microprocessor, a second memory device and a second data port all communicating with each other.

7. The apparatus of claim 6 wherein said data port is adapted to passing data in accordance with RS232 specifications.
8. The apparatus of claim 2 wherein the calculating means comprises a hand-held computer.
9. A method of providing diagnostics of a refrigeration system, the method comprising:
 - a) measuring liquid line refrigerant pressure (LP), suction line refrigerant pressure (SP), suction line temperature (ST), liquid line temperature (LT), and outdoor atmospheric temperature (AMB) used to cool the condenser;
 - b) when the liquid pressure port is not available, measure the discharge pressure (DP), setting LP equal to DP (or accounting for the condenser pressure drop);
 - c) calculating the pressure difference (PD) between the liquid pressure (LP) and the suction pressure (SP);
 - d) calculating the condensing temperature (CT) as the saturated temperature at the liquid line pressure (LP);
 - e) calculating liquid line subcooling (SC) using the liquid line temperature (LT) and the condensing temperature (CT);
 - f) calculating condensing temperature over ambient (CTOA) using CT and AMB;
 - g) calculating evaporating temperature (ET) as the saturated temperature at the suction pressure (SP);
 - h) calculating suction line superheat (SH) using suction line temperature (ST) and pressure (SP);
 - i) determining the presence of a fault and, if so, a consequent diagnostics of the refrigeration system based on operating limits for at least one of the following parameters: pressure difference (PD), evaporating temperature (ET), suction line superheat (SH), liquid line subcooling (SC), condenser temperature over ambient (CTOA).

10. The method of claim 9 further comprising:
 - a) measuring discharge refrigerant temperature (DT), return air temperature (RA), supply air temperature (SA), air off condenser temperature (AOC);
 - b) calculating condenser temperature difference (CTD) using AOC and AMB;
 - c) calculating evaporator temperature difference (ETD) using RA and SA.
 - d) determining the presence of a fault and, if so, a consequent diagnostics of the refrigeration system based on operating limits for at least one of the following parameters: condenser temperature difference (CTD) and evaporator temperature difference (ETD).
11. A method of providing diagnostics of a refrigeration system, the method comprising:
 - a) storing a plurality of HVAC system parameters that have been pre-defined for a particular refrigeration system;
 - b) defining a plurality of diagnostic instructions;
 - c) measuring at least five but not more than nine HVAC system variables;
 - d) calculating various HVAC operational variables based on the measurement of said at least five HVAC system variables;
 - e) comparing the calculated HVAC operational variables to said stored variables;
 - f) conveying at least one of said plurality of diagnostic messages to a person performing said diagnostics.
12. The method of claim 11 wherein said at least five measurements are three temperature measurements and two pressure measurements.

13. The method of claim 12 wherein said three temperature measurements are suction line temperature (ST), liquid line temperature (LT), and outdoor atmospheric temperature (AMB) used to cool the condenser.

14. The method of claim 12 wherein said two pressure measurements are external measuring liquid line refrigerant pressure (LP) and suction line refrigerant pressure (SP).

15. The method of claim 3 wherein said three measurements are all temperature measurements, including suction line temperature (ST), liquid line temperature (LT), and outdoor atmospheric temperature (AMB) used to cool the condenser.